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PORTERS'

NEW SYSTEM

OF

MATHEMATICS:

with the addition of a complete

READY RECKONER.

FOR THE USE OF FARMERS AND MECHANICS.

BY J. H. & R. PORTER, Jun.,
Teachers of Mathematics and Natural Philosophy.

P.B. Segee.

THIRD EDITION.

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INTRODUCTORY REMARKS.

It is foreign to our intention to augment the number of pages in this treatise by preliminary observations, we shall therefore mention briefly the design of its publication. Having been for a few years past engaged in teaching the science of Mathematics, and more recently on an abbreviated method, by cancellation, and perceiving that the minds of all were not sufficiently capacious to understand the more intricate and complicated parts of that interesting and useful science, which tends to discipline, invigorate and enlarge the powers of the mind, and wishing to facilitate and render more comprehensive its elucidation, and believing that a collection of propositions under the various rules used in mercantile transactions with suitable explanation, bound in a compendious form, which could be perused at pleasure, would tend to dispel from the mind those clouds of obscurity and uncertainty, and thereby greatly enhance its intrinsic value, we therefore devoted the few leisure moments we had to its compilation, and deem the reasons we have mentioned a sufficient apology for its presentation, to the citizens of an enlightened republic.

James H. Porter, Reuben Porter, Jr.

GENERAL RULE.

Place the figures as directed at the commencement of each rule, and then cancel on opposite sides of the perpendicular line, all equal ciphers, figures and numbers. If you can divide with a figure or number from one side into the other, cancel both numbers, and the quotient will remain on the side of the greater number. Then multiply the figures that remain on the right hand side of the line for a dividend, and those on the left for a divisor. The quotient will be the answer. Should the divisor exceed the dividend the answer is a fraction.

ARITHMETIC.

REDUCTION.

RULE. — Place the several constituents of the given commodity on the right hand side of the perpendicular line, and the number next inferior to that in which we wish our answer, on the left hand side.

Proposition 1. A gentleman purchased 24 yards of cloth, at 3 shillings per yard. Required the cost in dollars and cents, New York currency.

Ans. 9 dollars.

	24-3
-8	3
	1

$9 Ans.

2. Purchased 36 yards of satin at 4s. 6d. per yard. Required the cost in dollars and cents, New England currency. Ans. 27 dolls.

3. A gentleman bought 108 pounds of tea, at 7s. 6d. per pound. What was the cost in dollars and cents, New Jersey currency. Ans. 108 dolls.

4. Required the cost of 28 pounds of young hyson tea, at 6s. 8d. per pound, in dollars and cents, South Carolina currency. Ans. 40 dolls.

5. A man bought 3 hogsheads of melasses, each hogshead contained 120 gallons, at 1s. 8d. per gallon. Required the cost in federal money, New York currency. Ans. 75 dolls.

6. A gentleman purchased 8 hogsheads of oil, each hogshead contained 140 gallons, at 6s. 2d. per gallon. Required the cost in federal money, New England currency. Ans. 1151⅑ dolls.

7. Purchased 4 pieces of cloth, each piece containing 30 yards, at 1s. 4d. per yard. Required the cost in federal money, New Jersey currency.
Ans. 21⅓ dolls.

8. A gentleman bought 2 bales of cloth, each bale contained 42 pieces, and each piece 30 yards, at 2s. 6d. per yard. Required the cost in federal money, South Carolina currency.
Ans. 1350 dolls.

9. A gentleman purchased 12 hogsheads of melasses, each hogshead contained 120 gallons, at 3s. 4d. per gallon, and paid for the same with cloth, at 6s. 8d. per yard. Required the number of yards he gave in exchange. Ans. 720 yards.

10. A merchant bought 12 tons of iron, at 4d. per pound and paid for the same with melasses, for which he was allowed 2s. 4d. per gallon. Required the number of hogsheads he gave in exchange, allowing each hogshead to contain 80 gallons.
Ans. 48.

11. A gentleman purchased 6 tons of bar iron, at 6d. per pound, (New York currency,) and paid for

the same with candles, for which he was allowed 15s. (New England currency,) per box. How many boxes of candles were required ?

Ans. 336.

12. A philanthropist distributed a certain amount of money among 42 poor widows, giving them each 4s. 2d. Required the amount of his distribution in federal money, S. Carolina currency.

Ans. $37 50.

13. Supposing the circumference of a wheel to be 15 feet, how many times will it revolve in going from Boston to Dedham, the distance being 10 miles ?

Ans. 3520 times.

14. How many times did Captain Cook sail the length of his vessel in circumnavigating the globe, the circumference being 24,800 miles, and the length of the vessel 240 feet ? Ans. 545600 times.

15. The circumference of a large wheel is 36 feet, and that of a small one 18 inches. How many more revolutions will the latter make than the former, in going from Schenectady to Rochester, the distance being 140 miles ? Ans. 472 266.

16. The distance from Lowell to Boston is 26 miles, allowing the average width of the road to be 4 rods, how many acres would be contained therein ?

Ans. 208 acres.

REDUCTION OF CURRENCIES.

To change pounds shillings and pence into dollars and cts.

Rule.—Place the number of pounds given, on the right hand side of the perpendicular line, then see the proportion of United States' money, and place the number of pounds in that currency on the left hand side, and the equality of dollars on the right.

Prop. 1. Reduce £160, New York currency, to federal money. Ans. $400.

£-2 | 160—80
    | 5 $

400 $ Ans.

2. Reduce £ 240, New Jersey currency, to federal money. Ans. $640.

3. Reduce £ 243, New Jersey currency, to federal money. $648.

4. Reduce £ 140, South Carolina currency, to federal money. $600.

5. Reduce £ 560, South Carolina currency, to federal money. $2400.

6. Reduce £ 27, New England currency, to federal money. $90.

7. Reduce £80, New York currency, to federal money. $150.

8. Reduce £ 45 12s. New Jersey currency, to federal money. $ 121 60.

9. Reduce £112, Georgia currency, to federal money. $ 480.

To change dollars and cents to pounds, shillings and pence.

RULE. — Place the number of dollars given, on the right hand side of the perpendicular line, then set the proportion of United States' money, and place the number of dollars in that currency on the left hand side, and the equality of pounds on the right.

Prop. 1. Reduce $ 648 to pounds, New Jersey currency. Ans. 243 pounds.

-8 | 648 — 81
| 3£

£243 Ans.

2. Reduce $450 to pounds, New York currency, Ans. 180 pounds.

3. Reduce $360 to pounds, New England currency. Ans. 108 pounds.

4. Reduce $ 240 to pounds, South Carolina currency. Ans. 56 pounds.

5. Reduce $ 580 to pounds, Canada currency. Ans. 145 pounds.

6. Reduce $ 642 857 to pounds, South Carolina currency. Ans. 150 pounds.

7. Reduce $141 to pounds, New England currency. Ans. 42£ 6s.

8. Reduce $ 250 to pounds, Canada currency. Ans. 62£ 10s.

9. Reduce $ 125 60 to pounds, New Jersey currency. Ans. 47£ 2s.

10. Reduce $ 475 75 to pounds, New York currency. Ans. 190£ 6s.

11. Reduce $ 75 to pounds, New England currency. Ans. 22£ 10s.

12. Reduce $ 384 to pounds, Nova Scotia currency. Ans. 96£.

MULTIPLICATION OF FRACTIONS.

Rule. — In the Multiplication of Fractions, place the numerators, both of the multiplicand and multiplier, on the right hand side of the perpendicular line, the denominators on the opposite side.

Problem 1. Multiply $\frac{2}{3}$ of $\frac{4}{5}$ of $\frac{3}{4}$ by $\frac{10}{12}$.

Solution.

$$\begin{array}{r|l} \cancel{3} & \cancel{2} \\ \cancel{5} & \cancel{4} \\ \cancel{4} & \cancel{3} \\ 3\text{–}\cancel{6}\text{–}\cancel{12} & \cancel{10}\text{–}\cancel{2} \end{array}$$

Ans. $\frac{1}{3}$.

2. Multiply $\frac{1}{2}$ by $\frac{1}{4}$. Ans. $\frac{1}{8}$.
3. " $\frac{1}{4}$ by $\frac{1}{2}$. Ans. $\frac{1}{8}$.
4. " $\frac{1}{3}$ of $\frac{3}{4}$ by $\frac{4}{9}$. Ans. $\frac{1}{9}$.
5. " $\frac{4}{5}$ by $\frac{1}{3}$ of $\frac{3}{4}$. Ans. $\frac{1}{5}$.
6. " $\frac{1}{3}$ of $\frac{2}{5}$ of $\frac{3}{4}$ by $\frac{1}{2}$ of $\frac{5}{6}$. Ans. $\frac{1}{24}$.
7. " $\frac{7}{8}$ of $\frac{9}{10}$ of $\frac{8}{9}$ of $\frac{5}{6}$ by $\frac{2}{3}$ of $\frac{6}{7}$. Ans. $\frac{1}{3}$.
8. " $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{4}{5}$ by $\frac{5}{6}$ of $\frac{6}{7}$ of $\frac{7}{8}$. Ans. $\frac{1}{8}$.

9. Multiply $\frac{3}{4}$ of $\frac{7}{8}$ of $\frac{4}{7}$ by $\frac{1}{2}$ of 8. Ans. $1\frac{1}{2}$
10. " $\frac{1}{2}$ of $\frac{9}{7}$ of $\frac{4}{5}$ of $\frac{7}{9}$ of $\frac{5}{4}$ by $\frac{2}{3}$ of 3. Ans. 1.
11. " $\frac{6}{7}$ of $\frac{4}{9}$ of $\frac{7}{4}$ of $\frac{1}{6}$ by $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{4}{5}$ of 10. Ans. $\frac{5}{9}$.
12. " $\frac{1}{2}$ of $\frac{4}{5}$ of $3\frac{1}{2}$ by $\frac{1}{7}$ of $\frac{2}{4}$ of 5. Ans. $\frac{1}{2}$.
13. " $\frac{3}{4}$ of $\frac{7}{8}$ of $\frac{4}{7}$ of $4\frac{1}{4}$ by $\frac{8}{17}$ of $3\frac{1}{3}$ of $\frac{4}{10}$. Ans. 1.
14. " $2\frac{1}{2}$ of $\frac{4}{5}$ of 8 by $3\frac{1}{4}$ of $\frac{7}{13}$ of $\frac{6}{7}$ of 4. Ans. 96.
15. " $\frac{3}{4}$ of $\frac{7}{8}$ of $\frac{4}{7}$ of $3\frac{1}{2}$ of $\frac{6}{7}$ by $4\frac{4}{5}$ of $\frac{7}{12}$. Ans. $3\frac{3}{20}$.
16. " $4\frac{4}{5}$ by $\frac{10}{12}$ of $\frac{1}{4}$. Ans. 1.
17. " $3\frac{1}{3}$ of $\frac{3}{5}$ by $\frac{1}{2}$ of $\frac{1}{4}$ of 4. Ans. 1.
18. " $5\frac{3}{5}$ of $\frac{6}{7}$ of $\frac{3}{4}$ by $\frac{1}{6}$ of 8. Ans. $4\frac{4}{5}$.
19. " $2\frac{6}{7}$ of $\frac{5}{10}$ of $\frac{2}{5}$ of $\frac{1}{2}$ by 4 and $\frac{4}{5}$ of $\frac{5}{8}$. Ans. $\frac{4}{7}$

20. What will $2\frac{1}{3}$ lbs. of beef cost at $1\frac{1}{5}$ cents per lb. ? Ans. $2\frac{4}{5}$ cts.

21. Required the cost of $3\frac{1}{3}$ lbs. of pork at $4\frac{4}{5}$ cents per lb. Ans. 16 cts.

22. Required the cost of $\frac{1}{4}$ of $\frac{4}{5}$ of $3\frac{1}{3}$ yards of tape at $2\frac{1}{4}$ cents per yard. Ans. $1\frac{1}{2}$ cts.

23. What will $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{4}{5}$ of $2\frac{1}{2}$ yards of ribbon cost at $\frac{2}{3}$ of $5\frac{3}{4}$ cents per yard ? Ans. $4\frac{19}{24}$ cts.

24. A gentleman purchased $\frac{6}{7}$ of $\frac{2}{6}$ of $\frac{1}{5}$ of 7 yards of cassimer at $\frac{2}{3}$ of 3 dollars per yard. Required the cost. Ans. $\frac{4}{5}$ of a dollar.

25. Required the cost of $\frac{2}{3}$ of $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{6}{7}$ of $5\frac{1}{3}$ yards of satinet at $\frac{1}{2}$ of $\frac{3}{4}$ of $3\frac{2}{6}$ dollars per yard. Ans. $2\frac{1}{2}$ dollars.

26. Required the cost in dollars and cents of $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{4}{5}$ of $\frac{6}{7}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of $4\frac{4}{5}$ yards of broadcloth at $\frac{5}{6}$ of $\frac{9}{10}$ of $\frac{3}{4}$ of $\frac{10}{12}$ of $\frac{7}{13}$ of $8\frac{2}{3}$ dollars per yard. Ans. \$ 1 $31\frac{25}{100}$.

27. What will $\frac{1}{6}$ of $\frac{6}{7}$ of $\frac{1}{5}$ of $\frac{7}{8}$ of $\frac{8}{12}$ of $\frac{5}{8}$ of $2\frac{1}{3}$ yards

of cloth cost in dollars and cents, at $\frac{1}{3}$ of $\frac{15}{16}$ of $\frac{4}{5}$ of $12\frac{1}{2}$ dollars per yard? Ans. $ 2 50.

28. Required the cost in dollars and cents of $\frac{3}{5}$ of $\frac{9}{10}$ of $\frac{9}{11}$ of $\frac{12}{13}$ of $\frac{10}{11}$ of $\frac{13}{15}$ of $3\frac{3}{4}$ of $\frac{1}{2}$ of $\frac{5}{8}$ of $\frac{2}{3}$ of $\frac{8}{11}$ of $\frac{3}{10}$ of $\frac{13}{16}$ of $\frac{2}{5}$ of a yard of pilot cloth, at $\frac{1}{3}$ of $\frac{5}{6}$ of $\frac{3}{4}$ of $\frac{9}{5}$ of $3\frac{1}{2}$ of $\frac{1}{8}$ of $\frac{2}{5}$ of $3\frac{3}{4}$ of $\frac{3}{10}$ of a dollar per yard.

Ans. $ 0.00.166+.

29. A gentleman purchased $\frac{4}{5}$ of $\frac{3}{10}$ of $\frac{3}{4}$ of $\frac{8}{9}$ of $\frac{5}{8}$ of $4\frac{4}{5}$ of $\frac{8}{11}$ of $\frac{1}{2}$ of a yard of broadcloth at $\frac{3}{5}$ of $\frac{1}{2}$ of $\frac{1}{6}$ of 8 dollars per yard. Required the cost in dollars and cents. Ans. $ 0 18 61+.

DIVISION OF FRACTIONS.

Rule. — In the Division of Fractions, place the numerators of the dividend, and the denominators of the divisor on the *right* hand side of the perpendicular line; and the denominators of the dividend, and the numerators of the divisor on the *left* hand side.

Problem 1. Divide $\frac{1}{5}$ of $\frac{5}{6}$ by $\frac{1}{6}$ of $\frac{2}{3}$.

$$\text{Solution.}\qquad \begin{array}{r|l} \cancel{5} & 1 \\ 6 & \cancel{5} \\ 1 & \cancel{6} \\ 2 & 3 \end{array} \qquad \text{Ans. } 1\tfrac{1}{2}.$$

2. Divide $\frac{1}{2}$ by $\frac{1}{4}$. Ans. 2.

3. " $\frac{1}{4}$ by $\frac{1}{2}$. Ans. $\frac{1}{2}$.

4. " $\frac{1}{3}$ by $\frac{1}{2}$ Ans. $\frac{2}{3}$.

5. Divide $\frac{1}{2}$ by $\frac{1}{3}$. Ans. $1\frac{1}{2}$.

6. " $\frac{1}{4}$ of $\frac{1}{2}$ by $\frac{1}{8}$. Ans. 1.

7. " $\frac{1}{8}$ by $\frac{1}{4}$ of $\frac{1}{2}$. Ans. 1.

8. " $\frac{5}{6}$ of $\frac{7}{8}$ by $\frac{1}{4}$ of $\frac{4}{5}$. Ans. $3\frac{31}{48}$.

9. " $\frac{5}{6}$ of $\frac{2}{9}$ by $\frac{3}{4}$ of 5. Ans. $\frac{4}{81}$.

10. " $\frac{1}{4}$ of $\frac{4}{5}$ by $\frac{1}{2}$ of 6. Ans. $1\frac{1}{5}$

11. ' $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{4}{5}$ by $\frac{1}{3}$ of 2. Ans. $\frac{3}{4}$.

12. " 6 by $\frac{1}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$. Ans. 30.

13. " $\frac{1}{2}$ of 3 by $\frac{1}{3}$ of 2. Ans. $2\frac{1}{4}$.

14. " $\frac{1}{3}$ of 2 by $\frac{1}{2}$ of 3. Ans. $\frac{4}{9}$.

15. " $1\frac{1}{3}$ by 4. Ans. $\frac{1}{3}$.

16. " $2\frac{1}{2}$ by $\frac{1}{2}$ of 5. Ans. 1.

17. " $\frac{1}{2}$ of 5 by $2\frac{1}{2}$. Ans. 1.

18. " 3 $\frac{2}{6}$ of 10 by 10. Ans. $3\frac{1}{3}$.

19. " $\frac{2}{6}$ of $\frac{3}{4}$ of 4 by $2\frac{2}{5}$. Ans. $\frac{5}{12}$.

20. 18 men purchased $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{6}$ of $\frac{7}{6}$ of 24 yards of cloth and divided it equally. Required the share of each. Ans. $\frac{7}{36}$ of a yard.

21. 4 men bought $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of $4\frac{4}{5}$ pounds of sugar, and divided it equally between them. Required the share of each. Ans. $\frac{3}{10}$ of a lb.

22. $\frac{4}{5}$ of $\frac{5}{8}$ of $\frac{6}{7}$ of $\frac{7}{9}$ of 8 yards of calico were purchased by $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{1}{3}$ of 40 men, and each shared equally. Required the share of each.
Ans. $\frac{2}{3}$ of a yard.

23. The ship Constellation was purchased by $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{4}{5}$ of $\frac{6}{7}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of $\frac{8}{9}$ of 720 men for $\frac{3}{4}$ of $\frac{3}{12}$ of $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{10}{9}$ of $\frac{6}{7}$ of $\frac{7}{10}$ of $\frac{12}{14}$ of $\frac{6}{7}$ of $\frac{1}{2}$ of $\frac{3}{4}$ of 80 000 dollars, and each paid equally. Required the amount each paid.

24. $\frac{4}{5}$ of $\frac{6}{7}$ of $\frac{9}{10}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of $\frac{8}{9}$ of $\frac{3}{4}$ $\frac{10}{3}$ of 24 men built a house for $\frac{1}{2}$ of $\frac{4}{7}$ of $\frac{8}{9}$ of $\frac{2}{4}$ of $\frac{7}{8}$ of $\frac{9}{10}$ of $\frac{10}{2}$ of $\frac{7}{9}$ of $\frac{3}{7}$ of $\frac{2}{5}$ of $4\frac{4}{5}$ of $\frac{7}{12}$ of $\frac{6}{7}$ of $\frac{3}{4}$ $\frac{2}{3}$ of $\frac{5}{4}$ of $\frac{7}{3}$ of 1200 dollars, and each received equally. Required the amount each received.

25. $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{5}{6}$ of $\frac{4}{5}$ of $\frac{6}{7}$ of $\frac{7}{8}$ of 64 men freighted the ship Constantinople, bound for Monte Video, in South America, with tea, coffee and spice, the value of which was $\frac{6}{7}$ of $\frac{8}{9}$ of $\frac{7}{9}$ of $\frac{8}{10}$ of $\frac{10}{8}$ of $\frac{3}{4}$ of $\frac{6}{7}$ of $\frac{4}{5}$ of $\frac{7}{8}$ of 24 000 dollars, and each freighted equally as to value. Required the amount each received, allowing that each gained a sum equal to $\frac{1}{2}$ of $\frac{3}{5}$ of $\frac{2}{3}$ of $\frac{8}{10}$ of $\frac{4}{5}$ of $\frac{10}{7}$ of $\frac{1}{3}$ of the value of the cargo.

MULTIPLICATION AND DIVISION OF FRACTIONS COMBINED.

Problem 1. Multiply $\frac{2}{5}$ of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{4}{7}$ of $\frac{5}{8}$ by $4\frac{1}{8}$ and divide the product by $\frac{3}{8}$ of $\frac{2}{10}$ of $\frac{7}{8}$ of $\frac{5}{6}$ of $\frac{2}{5}$ of $\frac{3}{5}$ of $\frac{2}{11}$ of 70. Ans. $\frac{220}{441}$.

2. Multiply $\frac{2}{5}$ of 2 by $\frac{3}{6}$, and divide the product by $\frac{3}{8}$ of $\frac{2}{11}$ of $\frac{2}{10}$ of $\frac{3}{4}$ of 4. Ans. $1\frac{102}{243}$.

3. Multiply $\frac{5}{8}$ of $\frac{2}{10}$ of $\frac{2}{3}$ of $\frac{5}{12}$ of $\frac{5}{8}$ of $3\frac{2}{5}$, by $\frac{1}{5}$ of $\frac{4}{9}$ of $\frac{2}{10}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of $\frac{5}{11}$ and divide the product by $\frac{2}{3}$ of $\frac{4}{5}$ of $\frac{3}{8}$ of $\frac{2}{11}$ of $4\frac{1}{5}$. Ans. $\frac{5075}{[illegible]}$.

4. Multiply $\frac{5}{6}$ of $\frac{2}{10}$ of $\frac{3}{5}$ of $\frac{3}{11}$ of $\frac{2}{3}$ of $\frac{22}{41}$ by $\frac{5}{8}$ of $8\frac{3}{10}$ of $\frac{3}{4}$ of $\frac{23}{10}$ of $\frac{2}{6}$ of $\frac{5}{6}$, and divide the product by $\frac{2}{3}$ of $\frac{3}{11}$ of $\frac{22}{10}$ of $\frac{8}{11}$ of 14. Ans. $\frac{17457}{293888}$.

5. $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of 720 men purchased the ship Constellation for $\frac{3}{4}$ of $\frac{2}{12}$ of $\frac{1}{2}$ of $\frac{4}{6}$ of $\frac{2}{10}$ of $\frac{2}{12}$ of 80,000 dollars, and paid equally. Required the amount each paid. Ans. 11 11,1+

6. Multiply $\frac{3}{4}$ of $\frac{4}{7}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of $\frac{4}{5}$ of $\frac{4}{5}$ by $\frac{1}{2}$ of $\frac{4}{7}$ of $\frac{3}{8}$ of $\frac{3}{10}$ of $\frac{7}{8}$ and divide the product by $\frac{4}{9}$ of $\frac{1}{5}$ 3 of $\frac{3}{10}$ of $\frac{1}{4}$.

7. Multiply $\frac{1}{3}$ of 2 by $1\frac{1}{2}$ and divide the product by $\frac{1}{3}$ of $\frac{3}{4}$ of $\frac{7}{8}$ of $\frac{2}{3}$ of $\frac{4}{7}$ of $\frac{1}{3}$ of 160.

8. Multiply $\frac{5}{6}$ of $\frac{7}{8}$ of $\frac{3}{10}$ of $\frac{11}{14}$ of $\frac{10}{11}$ of 14 by $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{4}{5}$ of $\frac{7}{8}$ of 4, and divide the product by $\frac{3}{10}$ of $\frac{7}{8}$ of $\frac{14}{7}$ of 8.

9. Multiply $4\frac{4}{5}$ of $\frac{7}{12}$ of $\frac{5}{6}$ of $\frac{4}{7}$ of $3\frac{1}{5}$ of $\frac{3}{10}$ of $\frac{7}{15}$ of $3\frac{2}{3}$ of $\frac{4}{7}$ and divide the product by $6\frac{1}{4}$ of $\frac{4}{25}$ of $\frac{7}{8}$ of $\frac{4}{9}$ of 9.

10. Multiply $3\frac{3}{4}$ of $\frac{4}{7}$ of $\frac{7}{15}$ of $\frac{1}{3}$ of $\frac{7}{8}$ of $\frac{2}{7}$ of $\frac{5}{6}$ of $2\frac{1}{3}$ of $\frac{2}{3}$ by $7\frac{3}{4}$ of $\frac{15}{4}$ of 2, and divide the product by $\frac{4}{9}$ of $\frac{4}{5}$ of $\frac{7}{9}$ of $8\frac{4}{5}$ of $\frac{4}{25}$ of $4\frac{2}{3}$ of $\frac{4}{15}$ of 8.

11. Multiply $\frac{7}{9}$ of $\frac{11}{13}$ of $\frac{3}{11}$ of $\frac{15}{7}$ of $3\frac{2}{3}$ of $\frac{7}{8}$ of $\frac{5}{6}$ of 12 by $\frac{5}{6}$ of $\frac{2}{11}$ of $\frac{5}{6}$ of $\frac{11}{6}$ of $2\frac{1}{3}$ of $\frac{4}{5}$, and divide the product by $\frac{1}{4}$ of $\frac{3}{8}$ of $\frac{5}{8}$ of $\frac{5}{6}$ of 6.

SINGLE RULE OF THREE.

Rule.—In the Single Rule of Three there are two terms of the same denomination, the one a demand, the other a supposition. Place the demand on the *right* hand side of the line, and the supposition on the *left* hand side. The remaining term being of the same denomination as that in which we wish our answer, is placed on the *right* hand side of the line lastly.

Should the *effect* of the cause be required, the question is DIRECT; but if the *cause* be required, the question is INVERSE, and and in *this* case all positions of the cause *change places* over the line. Observe the *effect* never changes place, neither the answer required.

N. B.—Causes are men, horses, time, years, days, hours, capital or sum, &c. The effect is that which is produced by the causes as the work done, the grain consumed, the distances traveled, &c.

Proposition 1. If 3 yards of cloth cost 7 dollars, how many dollars will 9 yards cost? Ans. $21.

Solution,

$$\begin{array}{r|l} -3 & 9-3 \\ & 7 \\ & \overline{21} \text{ Ans.} \end{array}$$

2. What will 12 pounds of sugar cost if 4 pounds cost 35 cents? Ans. $1 05 cents.

3. If 3 yards of cloth cost 15 dollars, how many dollars will 12 yards cost? Ans. $60.

4. If 8 men mow 15 acres of grass in 3 days, how many acres will 48 men mow, in the same length of time? Ans. 90 acres

5. If 4 yards of cloth cost $8, what will 26 yards cost? Ans. $52.

6. If 2 yards of muslin cost 46 cents, what will 8 yards cost? Ans. $1 84.

7. If 7 horses consume 21 bushels of oats in 3 days, how many bushels will 3 horses consume in the same time? Ans. 9 bush.

8. If 28 lbs. of butter cost $5 88, what will 7 lbs. cost? $1 47.

9. If 3 yards of cloth cost $9, how many yards will $243 buy? Ans. 81 yards.

10. What will 30 lbs. of sugar cost, when 45 cents will buy 5 lbs. Ans. $2 70.

11. If 20 yards cost $120, how many yards may I have for $30. Ans. 5 yards.

12. If 7 lbs. of sugar cost 56 cents, how much will $7 12 buy? Ans. 89 lbs.

13. If 3 cords of wood cost $4 35, what will 27 cords cost? Ans. $39 15.

14. If 4 yards of cloth cost $35 50, how many yards may be bought for $106 50? Ans. 12 yds.

15. If 12 yards cost $9 72, what will 192 yards cost? Ans. $155 52.

16. How many bushels of wheat can be bought for $24, when 6 bushels cost $9? Ans. 16 bush.

17. If 7 lbs. of sugar cost 63 cts. what will 25 lbs. cost? Ans. $2 25.

18. If a man can travel 15 miles in 3 hours, how many miles can he travel in 5 hours?

Ans. 25 miles.

19. How many laborers must be employed to finish a piece of work in 15 days, which 5 men can do in 24 days? Ans. 8 men.

20. If 12 men can build a house in 30 days, how many will do it in 8 days? Ans. 45 men.

21. If a man perform a journey in 6 days, when the day is 8 hours long, in what time can he do it when the day is 12 hours long? Ans. 4 days.

22. If I lend my friend $100 for 180 days, how long ought he to lend me $450 to return my kindness? Ans. 40 days.

23. If 13 men can perform a piece of work in 35 days, in how many days would 5 men perform the same work? Ans. 91 days.

24. If 7 men do a piece of work in 16 days, how many men can do it in 4 days? Ans. 28 men.

25. If 20 horses eat 35 bushels of oats in a week, how many bushels will 8 horses eat in the same time? Ans. 14 bushels.

26. If 20 men can mow a field in 34 days, how many men can mow it in 8 days? Ans. 85 men.

27. If 8 men can build a wall in 20 days, how long will it take 5 men to build it? Ans. 32 days.

28. If 20 men can perform a piece of work in 35 days, how many men can do it in 7 days? Ans. 100 men.

29. If 12 oxen can eat 5 acres of grass in a week, how many acres will it take to keep 36 oxen the same time? Ans. 15 acres.

30. If my friend lends me $300 for 36 days, how long should I lend him $80 to repay his kindness? Ans. 135 days.

31. Suppose a man paints a house in 45 days, and works 8 hours a day, how long would it take him if he worked 9 hours a day? Ans. 40 days.

32. A man borrows of his friend $280, which he keeps 40 days; how much must he lend his friend 70 days as an equivalent? Ans. $160.

33. It takes 84 yards of paper that is 32 inches wide, to cover the walls of a room; how many yards will it take to cover another room of the same size, when the paper is 24 inches wide? Ans. 112 yards.

34. How much in length, 4½ inches broad, will make a foot square? Ans. 32 inches.

35. There is a cistern, having a pipe which will empty it in 15 hours; how many pipes of the same capacity will empty it in 3 quarters of an hour? Ans. 20 pipes.

36. What is the height of a tree, whose shadow is 180 feet, when a staff 5 feet long casts a shadow 9 feet? Ans. 100 feet.

37. If 12 pears are worth 21 apples, and 3 apples cost a cent, what will be the price of four score and four pears. Ans. 49 cts.

38. If a field will feed 6 cows 91 days, how long will it feed 21 cows ? Ans. 26 days.

39. If fifty gallons of water in one hour fall into a cistern containing 230 gallons, and by a pipe in the cistern 35 gallons run out in an hour, in what time will it be filled ? Ans. 15⅓ hours.

RULE OF THREE BY REDUCTION.

PROPORTION OF UNITED STATES MONEY.

In Penn. N. Jersey, Del. and Maryland,	3£=	$8 00
	3s. =	40
	9d.=	10
In New York and North Carolina,	2£.=	$5 00
	2s.	50
	24d. =	25
In New England and Virginia,	3£=	$10 00
	3s. =	50
	18d. =	25
In South Carolina and Georgia,	7£=	$30 00
	7s. =	1 50
	14d. =	25

RULE — Arrange the numbers on the line as taught in the Single Rule of Three, then *reduce* the first and third terms to the same denomination, and the second to that in which we wish our answer.

Proposition 1. If 1 pint of wine cost 10 pence, how many £ will 3 hogsheads cost at that rate ?

Solution.	1	3– hogsheads
	1	63 gallons
	1	4– quarts
	1	2– pints
pence	3 –12	10– pence
shillings	–2 –20	1 shilling
		1 pound

Ans. 63£.

2. If 1 gill of cider cost 3 pence, how many £ will 20 gallons cost? Ans. 8£.

3. If one quart of vinegar cost 8 pence, how many £ will five hogsheads cost? Ans. 42£.

4. If 4 pounds of nails cost 18 pence, how many £ will 12 tons cost? Ans. 504£.

5. If 12 tons of nails cost 504£ how many pence will 4 pounds cost? Ans. 18 pence.

6. If 3 hogsheads of wine cost 63£ what will 1 pint cost? Ans. 10 pence.

7. If 4 pounds of iron cost 18 pence, how many dollars (New England currency) will 12 tons cost at the same rate? Ans. $1680.

8. If 12 tons of iron cost 1680 dollars, (New England currency,) how many pence will four pounds cost? Ans. 18 pence.

9. If 18 pence will buy 4 pounds, how many tons can be purchased for 1680 dollars (New England currency?) Ans. 12 tons.

10. If 1680 dollars (New England currency) will buy 12 tons of iron, how many pounds can be purchased for 18 pence? Ans. 4 pounds.

11. If 9 pounds of nails cost 6 shilings, (New York currency) how many dollars will 30 tons cost?

Ans. $5600.

12. If 8 gallons of N. E. Rum cost 4 dollars, how many £ (N. Y. currency) will 15 pipes cost?

Ans. £378.

13. If 4 qts. of oats cost 16 pence, (New Jersey currency,) how many dollars will 60 bushels cost?

Ans. $8 53 33+.

14. If 3 pecks of beans cost 7 pence, (South Carolina currency,) how many dollars will 9 bushels?

Ans. $1 50.

DOUBLE RULE OF THREE,

OR

COMPOUND PROPORTION.

RULE. — Arange the question previous to placing the numbers on the line in the following manner. Let the *cause* possess the *first* place, *time* or *distance* the *second* place, and the remaining term the *third* place. Place those of the same name under each other; then should the *blank* space fall under the *first* or *second* terms, place the *third* and *fourth* terms on the left hand side of the line, and the three remaining terms on the *right* hand side: but should the *blank* space fall under the *third* term, place the *first* and *second* terms on the *left* hand side of the line, and the three remaining terms on the *right* hand side.

Proposition 1. If 4 men can mow 12 acres of grass in three days, how many acres can 16 men mow in 9 days?

Solution.

-4	16- 4
-3	9- 3
	12
	———
	144 acres. Ans.

2. If 4 men can mow 12 acres of grass in three days, how many men must be employed to mow 144 acres of grass in 9 days? Ans. 16 men.

3. If 16 men can mow 144 acres of grass in 9 days, how many men must be employed to mow 12 acres in 3 days? Ans. 4 men.

4. If 16 men can mow 144 acres of grass in 9 days in what time can 4 men mow 12 acres?

Ans. 3 days.

5. If 16 men can mow 144 acres of grass in 9 days, how many acres can 4 men mow in 3 days.

Ans. 12 acres.

6. If 4 men can mow 12 acres of grass in 3 days in what time can 16 men mow 144 acres?

Ans. 9 days.

7. If 8 horses consume 36 bushels of oats in 9 days, how many bushels will 24 horses consume in 12 days? Ans. 144.

8. If 8 horses consume 36 bushels of oats in 9 days, how many horses will be required to consume 44 bushels in 12 days? Ans. 24 horses.

9. If 8 horses consume 36 bushels of oats in 9 days, in what time will 24 horses consume 14 bushels? Ans. 12 days.

10. If 24 horses consume 144 bushels of oats in 12 days, how many bushels of oats will 8 horses consume in nine days? Ans. 36 bush.

11. If 24 horses consume 144 bushels of oats in 12 days, in what time will 8 horses consume 36 bushels. Ans. 9 days.

12. If 24 horses consume 144 bushels of oats in 12 days, how many horses will be required to consume 36 bushels in three days? Ans. 8 horses.

13. If 6 men can build a wall 80 feet long, 6 feet wide, and 4 feet high, in 15 days, how many men must be employed to build one 240 feet long, 8 feet wide and 6 feet high in 30 days? Ans. 18men?

14. If 6 men can build a wall 80 feet long 6 feet wide and 4 feet high, in 15 days, in what time can 18 men build one 240 feet long, 8 feet wide and 6 feet high. Ans. 30 days.

15. If 6 men can build a wall 80 feet long, 6 feet wide and 4 feet high, in 15 days, what will be the *length* of that wall which 18 men can build in 30 days, the width being 8 feet, and height 6 feet? Ans. 240 feet.

16. If 6 men can build a wall 80 feet long, 6 feet wide and 4 feet high, in 15 days, what will be the *width* of that wall which 18 men can build in 30 days, the length being 240 feet and the height being 6 feet? Ans. 8 feet.

17. If 6 men can build a wall 80 feet long, 6 feet wide and 4 feet high, in 15 days, what will be the *height* of that wall which 18 men can build in 30 days, the length being 240 feet and the width 8 feet? Ans. 6 feet.

18. If 18 men can build a wall 240 feet long, 8 feet wide and 6 feet high, in 30 days, how many men must be employed to build one 80 feet long, 6 feet wide and four feet high, in 15 days? Ans. 6 men.

19. If 18 men can build a wall 240 feet long, 8 feet wide and 6 feet high, in 30 days, in what time will six men build one 80 feet long, 6 feet wide, and 4 feet high? Ans. 15 days.

20. If 18 men can build a wall 240 feet long, 8 feet wide and 6 feet high, in 30 days, what will be the *length* of that wall which 6 men can build in 15 days, the width being 6 feet and height 4 feet? Ans. 80 feet.

21. If 18 men can build a wall 240 feet long, 8 feet wide and six feet high, in 30 days, what will the *width* of that wall be which 6 men can build in 15 days, the length being 80 feet and the height 4 feet? Ans. 6 feet.

22. If 18 men can build a wall 240 feet long, 8 feet wide and 6 feet high in 30 days, what will the *height* of that wall be which 6 men can build in 15 days, the length being 80 feet and width 6 feet? Ans. 4 feet.

23. Lent a friend $800 for 6 months, and at the expiration of the time received the interest, which

was 48 dollars, at what rate per cent. per annum did I receive interest? Ans. 12 per cent.

24. If 960 dollars defray the expenses of 20 men 88 weeks, for how many weeks will $1440 defray the expenses of 48 men, if they spend at the same rate? Ans. 55 weeks.

25. Suppose 4 men in 12 days mow 48 acres, how many acres can 8 men mow in 16 days?
Ans. 128 acres.

26. If 10 bushels of oats be sufficient for 18 horses 20 days, how many bushels will serve 60 horses 36 days? Ans. 60 bushels.

27. If 4 dollars be the hire of 8 men for 3 days, how many days must 20 men work for 40 dollars?
Ans. 12 days.

28. If 8 men can build a wall 24 feet long, 14 feet high, and 4 wide in 18 days, in how many days will 15 men build a wall 175 feet long, 8 feet high, and 6 wide? Ans. 60 days.

29. If a footman travel 240 miles in 12 days, when the days are 12 hours long, how many days will be required to travel 720 miles, when the days are 16 hours long? Ans. 27 days.

30. If 14 men can dig a ditch 36 feet long, 7 wide, and 8 deep, in 16 days, how many men will it take to dig another ditch 240 feet long, 9 wide, and 5 deep, in 10 days? Ans. 120 men.

31. If to make 2½ yards of cloth 6 quarters wide it requires 12 ounces of wool, how much wool will it take to make 140 yards, 4 quarters wide?
Ans. 28 lbs.

32. If 350 dollars, in 9 months, gain 15 dollars, what principal will gain 6 dollars in 12 months? Ans. 105 dollars.

33. If 8 men can build a wall 20 feet long, 6 feet high and 4 feet thick in 12 days, in what time can 24 men build one 200 feet long, 8 feet high and 6 feet thick? Ans. 80 days.

34. A wall 32 feet high and 40 feet long was built in 8 days by 145 men, in how many days would 68 men build another wall 28 feet high and of the same length, allowing each man to perform an equal portion of labor in the same time? Ans. $14\frac{63}{68}$ days.

35. What must be paid for the transportation of 56 bags of coffee, each weighing 3 qr. 16 lbs., 66 miles, if 14 bags weighing each 125 lbs., be carried 6 miles for 6 dollars 25 cents. Ans. 220 dollars.

36. If 100 pounds gain 6 pounds in 12 months, what principal, at the same rate per cent. will gain 3 pounds 7 shillings 6 pence in 9 months?

Ans. 75 pounds.

37. If a man travel 240 miles in 12 days, when the days are 12 hours long, in how many days of 16 hours, will he travel 720 miles, if he travel at the same rate? Ans. 27 days.

38. If twelve bushels of wheat are sufficient for a family of four persons nine months, how many bushels will be sufficient for a family of eight persons twelve months? Ans. 32 bush.

39. If the carriage of five cwt. 150 miles cost 20 dollars, eighty cents, what must be paid for the carriage of eight cwt. sixty miles? Ans. 13.312 dolls.

RULE OF THREE IN FRACTIONS.

Rule. — Place the numerators of the second and third terms on the *right* hand side, and the numerator of the first term on the *left*. The denominators are to be placed opposite the numerators

Proposition 1. If $\frac{3}{4}$ of a yard of cloth cost 6 dollars, what will 9 yards cost? Ans. 72 dolls.

2. If $\frac{7}{8}$ of a yard of cloth cost 14 dollars, what will 4 yards cost? Ans. 64 dolls.

3. If $\frac{1}{2}$ of $\frac{2}{3}$ of a yard of silk cost 6 shillings, what will 3 yards cost? Ans. 54s.

4. If $\frac{4}{5}$ of $\frac{5}{8}$ of a yard of ribbon cost 18 cents, what will 7 yards cost? Ans. $2 52.

5. If $\frac{1}{3}$ of $\frac{2}{5}$ of $\frac{3}{4}$ of a yard of silk cost 50 cents what will $\frac{1}{2}$ of 8 yards cost? 20 dolls.

6. If $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of a yard of satin cost 1 dollar what will $\frac{3}{4}$ of $\frac{4}{5}$ of 5 yards cost? Ans. 12 dolls.

7. If $\frac{2}{3}$ of $\frac{3}{4}$ of $2\frac{1}{2}$ yards of cassimer cost $\frac{1}{2}$ of 5 dollars, what will 2 yards cost? Ans. 4 dolls.

8. If $\frac{6}{7}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of 6 yards of satinet cost 84 cts. what will $\frac{4}{5}$ of $\frac{6}{9}$ of $\frac{5}{6}$ of 9 yards cost?

Ans. $89\frac{3}{5}$ cents.

9. If $\frac{6}{8}$ of $\frac{4}{6}$ of $\frac{8}{9}$ of $\frac{9}{10}$ of $3\frac{1}{3}$ yards of broadcloth cost $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of 4 dollars, what will $\frac{7}{12}$ of $\frac{1}{2}$ of $4\frac{4}{5}$ yards cost? Ans. $ 1 05, or $\frac{1}{20}$.

10. If $\frac{5}{8}$ of $\frac{3}{7}$ of $\frac{8}{12}$ of $\frac{7}{8}$ of 12 yards of petersham cost $\frac{7}{8}$ of $\frac{9}{10}$ of $\frac{8}{9}$ of 10 dollars, what will $\frac{3}{4}$ of $3\frac{1}{3}$ yards cost? Ans. $9\frac{1}{3}$ dolls.

11. If $\frac{1}{7}$ of 7 yards of cloth cost 49 cents, what will $\frac{6}{7}$ of $\frac{8}{9}$ of $\frac{7}{8}$ of 8 yards cost? Ans. $2 $61\frac{1}{3}$.

CONJOINED PROPOR

RULE.—When it is required to find how m
coin, weight or measure, mentioned in the
given quantity of the last, place the number
on the *right* hand side of the line, observin
stand on the right hand side; but when it i
many of the *last* sort are equal to a given qu
the numbers alternately, beginning on the *le*
and let the last number stand on the right h

Proposition 1. If 100 lbs. Eng
Flemish, and 19 lbs. Flemish 25 lb
many pounds English are equal to

Solution.

-5 -95	100-
-25	19-
	50-

2. If 40 pounds at New York
Antwerp, and 30 pounds at Antw
at Leghorn, how many pounds
equal to 144 pounds at Leghorn?

3. If 17 pounds of raisins are
almonds, and 5 pounds of almon
of figs, and 37½ pounds of figs v
tamarinds, how many pounds of
in value to 42½ pounds of raisins

4. If A can do as much work
do in 4½ days, and B as much i
days, and C as much in 10 days
many days' work of D are equa
A?

INTEREST.

Rule.—Place the principal, time, and rate per cent. on the *right* hand side. If the time consist of years and months, reduce them to months, and place 12 (the number of months in a year,) on the *left* hand side. Should the time consist of months and days, reduce them to days or aliquoit parts of a month; if reduced to days, place 30 (days in a month) and 12 on the *left*; if to aliquoit parts of a month, place 12 only. Observe to point off two figures from the right for cents.

Proposition 1. Required the interest of 180 dollars for two months and 15 days, at 6 per cent.

Solution.

	180–15
–12	5
–2	6–3

Ans. $ 2 25.

2. Required the interest of 180 dollars for 6 months at 6 per cent. Ans. $5 40.

3. Required the interest of 120 dollars for 8 months at 3⅓ per cent. Ans. $ 2 66,6+.

4. Required the interest of 99 dollars for 2 months at 4⅘ per cent. Ans. $ 0 79,2.

5. Required the interest of 60 dollars for 4 months at 4 per cent. Ans. $ 0 80.

6. Required the interest of 176 dollars for 3 months and 10 days at 6 per cent. Ans. 2 93,3+.

7. Required the interest of 640 dollars for 2 months and 19 days.* Ans. $ 8 42,6+.

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[*] When no per cent. is mentioned, 6 per cent. is always understood.

8. Required the interest of 800 dollars for 4 months and 20 days. Ans. $ 18 66,6+.

9. Required the interest of 720 dollars for 3 months and 19 days. Ans. $ 13 08.

10. Required the interest of 480 dollars for six months and 5 days. Ans. $ 14 80.

11. Required the interest of $ 4 80 for 8 months and 6 days. Ans. $ 0 19,68.

12. Required the interest of $ 7 20 for 9 months and 9 days. Ans. $ 0 33,48.

13. Required the interest of 730 dollars for 9 months and 29 days, at 5 per cent. allowing 365 days to the year. Ans. $ 29 90.

14. Required the interest of 480 dollars for 1 year 6 months and 15 days, at 6 per cent. Ans. $ 44 40.

15. Required the interest of $ 19 20 for 2 years 4 months and 10 days. Ans. $ 2 72.

16. Required the interest of $384 40 for 3 years 2 months and 20 days. Ans. $74 31,73.

17. Required the interest of $ 99 99 for 2 years 6 month and 20 days. Ans. $ 15 33,18.

18. Required the interest of $ 600 48 for 2 years 9 months and 29 days. Ans. $ 101 98,15+.

19. Required the interest of 480 dollars for 6 years 6 months and 6 days. Ans. $ 187 68.

20. Required the interest of $ 960 60 for 4 years 4 months and 15 days. Ans. $ 252 15,75.

INSURANCE.

Rule. — Place the value of the property insured and the rate per cent. on the *right* hand side of the line, and 100 on the *left* hand side.

Proposition 1. Required the insurance on an East India ship and cargo valued at 124000 dollars at 12½ per cent.

Solution. -2 -100 | 124,000—15,500 dolls. Ans.
-4 | 50-

2. Required the insurance on 72000 dollars at 4⅘ per cent. Ans. 3456 dollars.

3. Required the insurance on the ship Constitution and cargo valued at 144000 dollars at 6⅔ per cent. Ans. 9600 dolls.

4. Required the insurance on 4 buildings each valued at 2800 dollars at 3⅓ per cent. Ans. $373⅓.

5. Required the insurance on the schooner Elizabeth Ann, and cargo; the value of the ship being 80 000 and that of the cargo ½ of ⅔ of ⅘ of ¾ of ⅚ of ⅞ of 6/7 of the value of the ship at 4 ⅘ per cent? Ans. $4320.

6. Required the insurance of the brig Hannah, and cargo, valued at $160 000 at 14⅖ per cent? Ans. $230 40.

COMMISSION.

Rule. — Place the value of the property deposited, and the rate per cent. of the commission on the *right* hand side of the line, and 100 on the *left* hand side.

Proposition 1. Required the commission on 800 dollars at 4 per cent.

Solution. -100 | 800-8
| 4
32 dollars Ans.

2. A gentleman received goods to the value of 1200 dollars to be sold on commission at $3\frac{1}{3}$ per cent. Required his commission. Ans. 40 dolls.

3. Required what a factor may demand on $4\frac{4}{5}$ per cent. commission for laying out $ 848 50.

Ans. $ 40 72,8.

4. Required my commission on $3\frac{4}{7}$ per cent. for $ 150 40. Ans. $ 5 $37\frac{1}{2}$.

5. Received goods to the value of 9000 dollars at $2\frac{1}{2}$ per cent. Required my commission.

Ans. 225 dolls.

6. A gentleman deposited in my care goods to the value of 17400 dollars, and allowed me $8\frac{1}{3}$ per cent. commission with which I purchased other goods to the value of 1450 dollars. How much had I left?

Ans. nothing.

DISCOUNT.

Rule.—Place the sum on which the discount is to be made on the *right* hand side of the line, and the amount of one dollar for the given time and rate per cent on the *left* hand side, and the quotient will be the present worth. Subtract the present worth from the sum due, and you will obtain the discount.

Proposition 1. What is the present worth of 600 dollars, due 4 years hence, at 5 per cent?

$$\begin{array}{lrr|l} \textbf{Solution.} & 100 & -120 & 600-5 \\ & 5 & & 100 \\ \cline{2-2} \cline{4-4} & 500 & & \$500 \text{ Ans.} \\ & 4 & & \\ \cline{2-2} & 2000 & & \\ & 100 & & \\ \cline{2-2} & 120 & & \end{array}$$

2. What must be discounted for the ready payment of 100 dollars, due a year hence, at 6 per cent a year? Ans. $5 66.

3. Bought goods amounting to $615 75, at 7 months credit; how much ready money must I pay, discount at 4½ per cent per annum? Ans. $600.

4. What is the difference between the interest and discount on $600 for 12 years, at 5 per cent?
Ans. Interest $360, discount $225, diff. $135.

5. What is the present worth of 572£, due 2 years hence, discounting at the rate of 6 per cent per annum? Ans. 600£.

EQUATION OF PAYMENTS.

RULE. — Multiply each payment by the time which must elapse before it becomes due, and place the sum of the products on the *right* hand side of the line, and the sum of the payments on the *left* hand side.

Proposition 1. A owes B $380, to be paid as follows — viz. $100 in 6 months, $120 in 7 months, and $160 in 10 months; what is the equated time for the payment of the whole debt?

Solution. 100 × 6 = 600
120 × 7 = 740
160 × 10 = 1600
-380 | 3040-8 **Ans. 8 months.**

2. A merchant has owing him 300£, to be paid as follows—50£ in 2 months, 100£ in 5 months, and the rest in 8 months; and it is agreed to make one payment of the whole; I demand the equated time.

Ans. 6 months.

3. F owes H $1000, whereof $200 is to be paid down, $400 in 5 months, and the rest in 15 months, but they agree to make one payment of the whole; when must that time be? Ans. 8 months.

4. A merchant has due to him a certain sum of money, to be paid one sixth in 2 months, one third in 3 months, and the rest in 6 months; what is the equated time for the payment of the whole?

Ans. 4⅓ months.

BARTER.

Note.—The principle involved in this rule is the same as that in Rule of Three.

Rule.—Place the several constituents of the commodity whose value is *given* on the *right* hand side of the line, and the constituents of those whose value is *required* on the *left* hand side.

Proposition 1. A has 120 bushels of wheat, worth 80 cents per bushel, for which B gave him 60 bushels of corn; what was the corn rated at per bushels?

Solution. 60 | 120=2
| 80 Ans. $1 60 per bush.

2. G has 12 hogsheads of melasses, each hogshead containing 120 gallons, valued at 40 cents per gallon, for which S gave him cloth valued at $4 80 per yard; how many yards of cloth must S give to G as an equivalent? Ans. 120 yards.

3. How much wheat, at $1 25 a bushel, must be given in barter for 50 bushels of rye, at 70 cents a bushel? Ans. 28 bushels.

4. What quantity of butter, worth 12½ cents a pound, must be given in exchange for 12 lbs of indigo, worth $2 25 per pound? Ans. 216 lbs.

5. B has 12 tons of iron, valued at 4 pence (New York currency) per pound, for which C gave him corn at $1 40 per bushel; how many bushels of corn did C give for the iron? Ans. 800 bushels.

PROFIT AND LOSS.

Rule. — When it is required to know what is gained or lost per cent., ascertain what the gain or loss is by subtraction, then place 100 and the gain or loss on the RIGHT hand side of the line; and the price it cost on the LEFT hand side. When it is required to know how a commodity must be sold to gain or lose so much per cent., place the value of the commodity and 100 with the gain per cent. added, or loss per cent. subtracted on the RIGHT hand side of the line, and 100 on the LEFT. When there is gained or lost per cent. to ascertain what the commodity cost, place the price at which it is sold and 100 on the RIGHT hand side of the line, and 100 with the gain per cent. added or loss per cent. subtracted, on the LEFT hand side. When any commodity is sold at a given rate, and by which so much can be gained or lost per cent., to know what would be gained or lost per cent., if sold at any other rate, place the FIRST price on the LEFT hand side of the line, and the other price with 100 and the profit per cent. added or loss per cent. subtracted on the RIGHT hand side of the line.

Proposition 1. A man purchased wine at 80 cents per gallon; how must he sell it per gallon to gain 20 per cent?

Solution. -5-100 | 80-16
| 120- 6
| ——
| 96 Ans. 96 cts.

2. A gentleman bought cloth at 4 dollars 80 cents per yard, but being damaged he is willing to lose 10 per cent., at what price per yard must he sell it?

Ans. $4 32.

3. A gentleman purchased 120 yards of cloth for six hundred dollars, how must he sell it per yard to gain 20 per cent.? Ans. 6 dolls.

4. At twenty-five cents profit in a dollar, how much per cent.? Ans. 25 per cent.

5. Bought ninety gallons of wine at one dollar twenty cents per gallon, but by accident ten gallons leaked out; at what rate must I sell the remainder per gallon to gain upon the whole prime cost at the rate of twelve and a half per cent.? Ans. $1 51,8+.

6. By selling broadcloth at three dollars twenty-five cts. per yard I lose at the rate of twenty per cent; what is the cost of the cloth per yard?
Ans. $4 06,25.

7. If forty pounds of chocolate be sold at twenty-five cents per pound, and I gain nine per cent, what did the whole cost me? Ans. $9 17,4+.

8. If I sell cloth at 5s per yard, and thereby gain fifteen per cent, what shall I gain per cent if I sell it at 6s per yard? Ans. 38 per cent.

9. If I retail oil at one dollar fifty cts, per gallon, and thereby gain twenty-five per cent, what shall I gain or lose per cent. if I sell it at one dollar eight cents per gallon? Ans. lose 10 per cent.

10. If I sell one hundred pounds of sugar for eight dollars and thereby lose twelve per cent., what shall I gain or lose per cent. if I sell four hundred pounds of the same sugar for thirty six dollars.
Ans. lose 1 per cent.

11. A gentleman sold a watch for 24 dollars and gained as much per cent. as the watch cost him; required the cost of the watch. Ans. 20 dolls.

12. A man sold a horse for one hundred and twenty dollars and thereby lost twenty per cent., whereas he ought to have gained thirty per cent.; how much was he sold under his real value? Ans. 75 dolls.

SINGLE FELLOWSHIP.

Rule. — Place the amount which each partner put in on the LEFT hand side of the perpendicular line, and the whole gain or loss, together with the stock each partner put in severally, on the RIGHT hand side.

Proposition 1. A B and C entered into partnership; A invested for hundred dollars, B six hundred and C one thousand, and they gained eight hundred dollars; what is each one's share of the gain?

```
                 400+600+1000=2000
-5-2000|800-160  -50-2000|800-20  2-2000| 800-400
       |400-             |600-12        |1000-
```

Ans. A's share $ 160, B's $ 240, C's $ 400.

2. Six gentlemen, A, B, C, D, E and F entered into partnership for one year; A put in two hundred dollars, B three hundred, C four hundred D five hundred, E six hundred, F eight hundred, and they gained five hundred and sixty dollars; what was each one's share of the gain?

Ans. A's share 40 dolls., B's 60, C's 80, D's 100, E's 120 and F's 160.

3. Divide the number 360 into three parts which shall be to each other as 2, 3 and 4.

Ans. 80, 120 and 160.

4. Two merchants have gained 450£, of which A is to have three times as much as B; how much is each to have?

Ans. A's share 337£, 10s., B's 112£ 10s.

5. Three persons are to share 600£; A is to have a certain sum, B as much again as A, and C three times as much as B; what is each part?

Ans. A's 66⅔£, B's 133⅓£, and C's 400£.

COMPOUND FELLOWSHIP.

Rule. — Multiply each man's stock by the time during which he continued in trade, then place the amount of the several products on the LEFT hand side of the line, and the gain or loss, together with the product of the stock of each of the partners severally multiplied by the time, on the RIGHT hand side.

Proposition 1. Three merchants entered into partnership; A put in 200 dollars for two months, B put in 400 for 3 months, and C put in 200 for 7 months; they gained 600 dollars; what is each's share?

Solution. 200 × 2 = 400
400 × 3 = 1200
200 × 7 = 1400

-5-3000	600-	-5-3000	600-	-5-3000	600-
	400-80		1200-240		1400-280

Ans. A's share $80, B's 240, C's 280.

2. A, B, C, D, E, F, G and H entered into partnership; A's stock was three hundred dollars for four months, B's four hundred for six months, C's five hundred for eight months, D's six hundred for five months, E's eight hundred for three months, F's two hundred for five months, G's five hundred for two months, and H's one thousand for five months: they gained nine hundred and sixty dollars; required each one's share of the gain.

3. Two merchants traded in company, A put in 215 dollars for 6 months, and B 390 dollars for 9 months, but by misfortune they lose two hundred, how must they share the loss? Ans. A's $53 75 B's 146 25.

4. Three persons had received 66
A put in four thousand dollars for 1
thousand for 15 months, and C fiv
months; how much is each man's pa
Ans. A's $ 240,

5. A and B companied; A put
dollars Jan. 1, but B put in his share
he then put in to have an equal sh
with A?

6. Three merchants traded in co
one hundred and twenty dollars for
hundred for 18 months, and C one
months; they gained one hundred
each man's share? Ans. A's $

7. E and S enter into partners
first advances four hundred eighty
in his share 3 months after; how n
vance to be entitled to an equal sh
the expiration of one year?

8. Two merchants trading in
hundred dollars; A's stock was tv
dollars for six months, and B's thr
dollars for nine months, ; how oug
gain? Ans. A's part $ 55.69

9. Two men commenced tradin
1, 1841; A. advanced one thous
time specified, but B did not advan
first of May following; at the en
shared the profits equally; what
vance?

MENSURATION.

OR

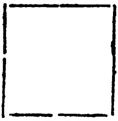
PRACTICAL GEOMETRY.

To find the area of a Square, a Rectangle, a Rhombus, or a Parallelogram.

RULE. — Place the BASE and PERPENDICULAR HEIGHT on the RIGHT hand side of the line, and the number next inferior to that corresponding to the answer on the LEFT hand side.

Proposition 1. Required the area of a square piece of land eighty rods square. Ans. 40 acres.

Solution.		
		80–40
	–2–160	80–



2. How many acres in a square piece of land whose side is 32 rods? Ans. 6⅖ acres.

3. Required the area of a square piece of land whose side is 15 chains? Ans. 22½ acres.

4. How many men can stand on 5 acres of land, each man occupying a space of three feet square? Ans. 24,2 0 men.

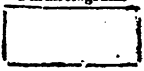
5. A gentleman purchased a farm in the form of a square, at 48 dollars per acre; required the cost allowing the side to be 25 chains. Ans. 3000 dolls.

6. Required the area of a parallelogram, whose base is 80 rods and altitude 25 rods.

Solution.		
	–2–160	80–
		25– 12½

or 12 acres 2 rods.

Parallelogram.



7. How many acres in a field in the form of a parallelogram, whose base is 95 rods and altitude 40 rods? Ans. 23 acres 3 roods.

8. Required the area of a field in the form of a parallelogram, whose base is 35 chains and altitude 10 chains. Ans. 35 acres.

9. Four gentlemen purchased a farm in the form of a parallelogram, the base thereof was 320 rods and altitude 90 rods, and divide it equally; required the portion of each. Ans. 45 acres.

10. Required the area of a rectangle, whose base is 28 feet and breadth 9 inches. Ans. 21 feet.

11. How many square feet are there in a rectangular board, whose length is 36 feet and breadth 10 inches? Ans. 30 feet.

12. Required the area of a rectangular farm, whose base is 88 rods and breadth 40 rods. Ans. 22 acres.

13. How many acres are there in a rectangular farm, whose base is 50 chains and breadth 20 chains? Ans. 100 acres

14. Required the area of a rhombus, whose base is 75 rods and breadth 40 rods. Ans. 18 acres 3 roods.

15. How many acres are there in a farm in the form of a rhombus, whose base is 45 chains and breadth 20 chains? Ans. 90 acres.

16. Required the area of a rectangular board, whose length is 20 feet and breadth 1 foot 4 inches. Ans. 26⅔ feet.

17. Required the area of a parallelogram whose base is 800 rods, and altitude 400 rods.

To find the area of a Triangle.

Rule. — Place the *altitude* and *half* the length of the *base* on the *right* hand side of the line, and the number next inferior to that corresponding to that, on the *left* hand side.

Note. — A triangle is equal to half a parallelogram of the same base and altitude; therefore the truth of this rule is evident.

Proposition 1. Required the area of a triangle, whose base is 60 rods and altitude 40 rods.

Solultion. -4-160 | 40–
| 30– $7\frac{1}{2}$ Ans. $7\frac{1}{2}$ acres.

2. Required the area of a triangle, whose base is 90 rods and altitude 60 rods.

Ans. 16 acres 3 roods 20 rods.

3. How many acres in a triangle, whose base is 120 rods and altitude 84 rods?

Ans. 31 acres 2 roods.

4. A gentleman purchased a triangular farm, the base thereof was 480 rods and altitude 120 rods. — Required the cost of said farm at 50 dollars per acre. Ans. $ 9000.

5. Required the value of a triangular farm the base being 70 chains and altitude 30 chains, at 64 dollars per acre. Ans. $ 6720.

6. Required the area of an equilateral triangle whose side is 12 chains and perpendicular 10 chains.

Ans. 6 acres.

7. Required the area of a right-angled triangle whose base is 140 rods and perpendicular 80 rods.

Ans. 35 acres.

8. Required the area of an isosceles triangle whose base is 40 chains and altitude 35 chains.

Ans. 70 acres.

9. Required the area of a scalene triangle whose base is 94 rods and perpendicular 60 rods,

Ans. 17 acres 2 roods 20 rods.

10. Eight gentlemen purchased a farm in the form of a right-angled triangle, the base thereof being 480 rods and perpendicular 140 rods, and divided it equally; required the share of each, Ans. 26¼. acres.

To Measure Wood, Bark, Coal, &c.

Rule. — Place the length, breadth and height on the right hand side of the line, and 128 (solid feet in a cord,) on the left hand side or place 8 (the length,) 4 (the width,) and 4 (the height. Should the length, breadth, or height be in feet and inches, reduce them to aliquoit parts of a foot

Proposition 1. How many cords of wood are there in a load twelve feet long, three feet four inches in width and six feet high?

Solution.		
	8	12– 3–
	–3	10– 5
	–4	6– 3
	–2 –4	

Ans. 1⅞ cords.

2. How many cords of wood in a pile forty feet long, eight feet wide and six high? Ans. 15 cords.

3. Required the cords of wood in a pile ninety feet long, three feet four inches wide and four feet high.

Ans. 9⅜ cords.

6. How many bushels of coal in a load twelve feet long, eight feet wide and four feet high, allowing one hundred bushels to the cord? Ans. 300 bushels.

4. Required the superficial area of a ball, the diameter being thirty-six inches and circumference 112 inches. Ans. 28 feet.

5. Supposing the earth's diameter to be eight thousand miles and the circumference twenty-five thousand. How many square miles would there be on its whole surface? Ans. 200000000.

6. Required the number of square miles on the whole surface of Jupiter, the diameter being eighty-nine thousand miles and the circumference 280000 miles? Ans. 24920000000.

To find the superficial area of a Globe, the diameter being given.

Rule. — Place the square of the diameter, the decimal ·7854 and 4 on the right hand side of the line, and the number next inferior to that corresponding to the answer on the left hand side of the line.

Proposition 1. Required the superficial area of a globe, the diameter being thirty-six inches.

	36—
—4—144	36
	·7854
	4—

28·2744 square.

2. Required the superficial area of a globe, the diameter being 144 inches. Ans. 452·3904 square feet.

3. Required the superficial area of the earth, its diameter being eight thousand miles.

Ans. 201062400 miles.

4. Required the superficial area of the planet Herschel, its diameter being thirty-five thousand miles.
Ans. 3848460000 miles.

5. Also that of the planet Saturn, its diameter being seventy-nine thousand miles, Ans. 19606725600.

To find the solidity of a Globe.

Rule. — Place the square of the diameter, the decimal ·7854, 4 and 1-6 of the diameter of the globe on the right hand side of the line, and the number next inferior to that corresponding to the answer on the left hand side.

Proposition 1. Required the solidity of a globe, its diameter being twenty-four inches.

–6 –144	24–
	24–4
	·7854
	4
	4

50,2656 cubic feet.

2. Required the solidity of a globe, its diameter being ninety-six inches. Ans. 3216,9984 feet.

3. Required the solidity of the planet Jupiter, its diameter being eighty-nine thousand miles.
Ans. 369121768400000 square miles.

4. Required the solidity of the planet Herschel, its diameter being thirty-five thousand miles.

5. Required the solidity of the planet Saturn, its diameter being 79,000 miles.

To find the convex surface of a right cone.

Rule. — Place the circumference of the base and altitude on the right hand side of the line, and 2 and the next inferior number to that corresponding to the answer, on the left hand side.

Prop. 1. Required the convex surface of a right cone, the circumference of whose base is 72 inches, and slant height or altitude 24 feet.

–2	72– 6
–12	24– 12
	72 feet Ans.

2. The circumference of the base of a right cone is 8 feet, and slant height 20 feet, required its convex surface. Ans. 80 feet.

3. Required the convex surface of a right cone, the circumference of whose base is 96 inches, and slant height 48 feet. Ans. 192 feet.

4. The diameter of a right cone is 21 inches, and the slant height 36 feet; required the convex surface. Ans. 98·9604 feet.

5. Required the convex surface of a right cone its diameter being 14 feet, and slant height 60 feet. Ans. 1319·472 feet.

6. The diameter of a right cone is 4·5 feet, and the slant height 20 feet; required the convex surface. Ans. 141·372 feet.

7. The circumference of the base is 10·75, and the slant height 18·25; what is the convex surface? Ans. 98·09375.

To find the convex surface of the frustrum

RULE. — Place the sum of the perimeters of t
the slant height on the right hand side of the lin
number next inferior to that corresponding to t
left hand side.

Prop. 1. Required the convex surfa
trum of a right cone, the circumfe
greater end being 30 feet, that of the
feet, and the length of the slant side 2

-2 | 40
| 20- 10

400 feet, Ar

2. Required the convex surface of
of a right cone the circumference of t
being 60 feet, that of lesser end 20
length of the slant side 40 feet.

3. If a segment of twelve feet slan
off a cone whose slant height is 60 fee
ference of its base twenty feet. Wh
of the frustrum?

4. Required the convex surface o
of a right cone, the diameter of the gr
22 feet, that of the lesser end seve
length of the slant side 16 feet. Ans

To find the solidity of a cone or pyramid.

Rule.—Place the square of the diameter, the decimal ·7854, and altitude on the right hand side, and 3 and the number next inferior to that corresponding to the answer on the left hand side.

Prop. 1. Required the solidity of a cone, the diameter being twenty inches and altitude or perpendicular height twenty-four feet.

-6-144	20
3	20
	.7854-1309
	24-
	17,4533 feet.

2. Required the solidity of a conical church spire, the diameter being twelve feet, and perpendicular height sixty feet. Ans. 2261,952 cubic feet.

3. The diameter of a cone is twenty feet and its perpendicular height twenty-four feet. Required its solidity. Ans. 2513,28 feet.

4. Required the solidity of a conical block of marble, its diameter being nine feet, and altitude twenty-four feet. Ans. 508,9392 cubic feet.

5. Required the value of a conical marble monument ot $ 12 50 per foot, the diameter of whose base is twelve feet, and perpendicular height thirty-six feet. Ans. $ 16964,64.

To find the number of gallons contained in a circular cistern.

Rule. — Place the square of the diameter, the length and 47 on the right hand side of the line, and 8 on the left hand side.

[This rule has never before, to our knowledge, been promulgate.]

Prop. 1. Required the number of gallons contained in a circular cistern, the diameter being six feet and height six feet.

Solution.

	6– 3
– 2 –4 –8	6– 3
	6– 3
	47

Ans. 1260 gallons.

2. Required the number of gallons contained in a circular cistern, the diameter being eight feet and the height four feet. Ans. 1504 gallons.

3. Required the number of gallons contained in a circular cistern, the diameter being twelve feet and height nine feet. 7614 gallons.

4. Required the number of gallons contained in a circular cistern, the radius being eight feet and height ten feet. Ans. 15040 gallons.

To find the solidity of a cylinder.

Rule, — Place the square of the diameter, the decimal ·7854, and altitude, on the right hand side of the line, and the next inferior number corresponding to the answer, on the left hand side.

Prop. 1. Required the solidity of a cylinder the diameter of whose base is thirty-six inches and length twenty feet.

Solution.

```
          | 36-
-4 -144   | 36- 9
          | 20
          | ·7854
           ------
           141·372 feet Ans.
```

2. Required the solidity of a cylinder whose diameter is nine inches and altitude twelve feet.

Ans. 5.30145 cubic feet.

3. Required the solid feet contained in a stick of timber of equal thickness, whose diameter is nine inches and length twenty four feet. Ans. 10·6029 feet.

4. Required the cubic feet contained in a round stick of equal bigness from end to end, the diameter of which being eighteen inches and length thirty-six feet. Ans. 63·6174 cubic feet.

MECHANICAL OPERATIONS

The two arms of a lever and the power being given, to find what weight that power will equiponderate.

RULE. — Place the length of the arm to which the power is applied, and the power on the right hand side of the line, and the length of the other arm on the left hand side.

Prop. 1. There is a lever thirty feet long divided by the fulcrum into two arms, one of which is twenty feet, the other ten feet in length. Required the equiponderating weight on the short arm when 120 pounds is suspended at the extremity of the long arm.

```
-10 | 20- 2
    | 120
  ------
  240 pounds Ans.
```

2. The arms of a lever are, the one thirty feet and the other four feet in length. What weight will a power of 160 pounds at the extremity of the long arm balance at the extremity of the short arm?

Ans. 1200 lbs.

3. How many lbs. will a power of nine lbs. placed fifteen feet from the fulcrum of a lever support at the extremity of the other arm two feet in length.

Ans. 67½.

The arms of a lever and the weight being given, to find the power.

Rule. — Place the weight and the length of the arm to which it is suspended on the right hand side of the line, and the length of the other arm on the left hand side.

Prop. 1. A weight of twenty tons is suspended to an arm of a lever six inches in length. What weight at the extremity of the other arm forty feet in length will balance the same?

```
        | 20- 10- 5 cwt. Ans.
-2 -12  | 20-
-2 -40  | 6-
```

2. A weight of 1400 lbs. is suspended to an arm of a lever eight feet in length. What weight at the extremity of the other arm fourteen feet in length will balance the same? Ans. 800 lbs.

3. A weight of four hundred tons is suspended to an arm of a lever ten inches in length. Required the weight at the extremity of the other arm five feet in length that will balance the same?

Ans. 66⅔ tons.

4. A weight of 7200 lbs. is suspended to an arm of a lever three feet in length. What weight at the extremity of the other arm nine feet in length will balance the same? Ans. $1\frac{1}{14}$ tons.

The diameter of the wheel, the diameter of the axle and the power being given, to find the weight.

Rule. — Place the diameter of the wheel and the power applied on the right hand side of the line, and the diameter of the axle on the left hand side.

Prop. 1. If the diameter of the axle be six inches and that of the wheel six feet, what weight attached to the axle will sixteen lbs., attached to the wheel, balance?

$$\begin{array}{r|l} & \cancel{6} \\ \cancel{6} & 12 \\ & 16 \\ \hline & 192 \text{ lbs. Ans.} \end{array}$$

2. If the diameter of the axle be eight inches and hat of the wheel twenty-four feet, what weight attached to the axle will 144 lbs. attached to the wheel balance? Ans. $2\frac{11}{35}$ tons.

3. If the diameter of the wheel be thirty-six feet and that of the axle four inches what weight attached to the axle will twelve cwt. attached to the wheel belance? Ans. $64\frac{4}{5}$ tons.

4. Supposing the diameter of the wheel to be forty-eight-feet and that of the axle ten inches, what weight attached to the axle would 100 tons attached to the wheel balance? Ans. 5760 tons.

5. Supposing the diameter of the wheel to be sixty feet and that of the axle twelve inches, what weight attached to the axle would 400 tons attached to the wheel balance? Ans. 2000 tons.

The diameter of the wheel, the diameter of the axle, and the weight being given, to find the power.

Rule. — Place the diameter of the axle and the weight on the right hand side of the line, and the diameter of the wheel on the left hand side.

Prop. 1. If the diameter of the axle be six inches and the diameter of the wheel twelve feet, what power will balance a weight of 360 lbs?

-2 -12	6-
-12	360- 30- 15 lbs. Ans.

2. If the diameter of the axle be eight inches and that of the wheel sixteen feet, what power will balance a weight of 2880 lbs? Ans. 120 lbs.

3. If the diameter of the wheel be twenty-four feet and that of the axle four inches, what power will balance a weight of forty tons? Ans. 11⅑ cwt.

4. If the diameter of the axle be nine inches and that of the wheel eight feet, what power will balance a weight of 144 tons? Ans. 13½ tons

The length, height of the plane and power being given, to determine the weight.

Rule.—Place the power and the length of the plane on the right hand side of the line, and the perpendicular height on the left hand side.

1. If the length of an inclined plane be sixteen feet and the perpendicular height four feet, what will a power of thirty-two pounds sustain?

$$\begin{array}{r|l} -4 & 16\text{–}4 \\ & 32 \\ \hline \end{array}$$

128 pounds, Ans.

2. What weight will four tons sustain on an inclined plane one hundred and forty-four feet in length and perpendicular height four feet.

Ans. 144 tons.

3. If the length of an inclined plane be eighty-four feet and perpendicular height three feet, what weight will a power of twenty tons sustain?

Ans. 560 tons.

4. What weight will twelve tons sustain on an inclined plane ninety-six feet in length and perpendicular height six feet? Ans. 192 tons.

If the length of an inclined plane be seventy-feet and perpendicular height 3½ feet, what will a power of one hundred sixty cwt. sus-

Ans. 172½ tons.

The length, height of the plane and weight being given to find the power.

Rule.—Place the weight and height of the plane on the right hand side of the line, and the length on the left hand side.

Proposition 1. What power will balance one hundred twenty-eight pounds on an inclined plane, the length of which is 16 feet and perpendicular height four feet.

$$\begin{array}{r|l} -16 & 128-8 \\ & 4 \\ \hline & \quad 32 \text{ pounds, Ans.} \end{array}$$

2. What power will balance twelve tons on an inclined plane, the length of which is twenty-four feet, and perpendicular height six feet? Ans. 3 tons.

3. What power will balance twenty tons on an inclined plane, the length of which is seventy-two feet and perpendicular height four feet? Ans. 1⅛ tons.

4. What power will balance one hundred and forty four cwt. on an inclined plane, the length of which is ninety-six feet, and the perpendicular height nine feet? Ans. 13½ cwt.

5. What power will balance thirty-six tons on an inclined plane, the length of which is two hundred and forty feet and perpendicular height eight feet? Ans. 24 cwt.

The thickness of the head, the length of the side and the power acting upon the head of the wedge being given to determine the force produced on the side.

Rule.—Place the length of the wedge and the power on the right hand side of the line and the thickness of the head on the left hand side.

Proposition 1. If the length of a wedge be twelve inches, the thickness of the head 3 inches and the force applied sixty-four pounds, what will be the rdsistence at the side?

```
-3|12-4
  |64
  ----
   256 pounds, Ans.
```

2. If the length of a wedge be twenty inches, the thickness of the head four inches, and the force applied one hundred and forty-four pounds, what will be the resistence at the side? Ans. 6$\frac{3}{7}$ cwt.

3. If the length of a wedge be thirty-six inches, the thickness of the head six inches and the force applied nine hundred sixty pounds, what will be the resistence at the side? Ans. 2$\frac{4}{7}$ tons.

4. If the length of a wedge be forty-eight inches, the thickness of the head eight inches, and the force applied ten thousand eight hundred pounds, what will be the resistence at the side? Ans. 28$\frac{13}{14}$ tons.

5. If the length of a wedge be sixty inches, the thickness of the head five inches and the force applied eight tons, what will be the resistence at the side?

Ans. 96 tons.

The length of the side, the thickness of the head, and the resistence upon the side of a WEDGE *being given, to find the force acting upon the head.*

RULE.—Place the resistence at the side and the thickness of the head on the right hand side of the line and the length of the side of the wedge on the left hand side.

Proposition 1. If the resistence at the side of a wedge be twenty thousand pounds, the length of the wedge twenty inches, and the thickness of the head three inches, what force is required to be applied to counteract the resistence at the sides?

$$\begin{array}{r|l} & \text{—} \\ -20 & 20000 \\ & 3 \\ \hline \end{array}$$

3000 pounds Ans.

2. If the length of the wedge be thirty-two inches the thickness of the headtwo inches, and the resistence at tho side be twenty-five thousand six hundred pounds, what must be the force upon the head, no allowance being made for friction?

Ans. 1600 pounds.

3. If the resistence at the side of the wedge be twelve tons the length of the wedge twenty-four inches and the thickness of the head four inches, what force is required to be applied to counteract the resistence at the sides? Ans. 2 tons.

4. If the length of the wedge be forty-eighty inches, the thickness of the head six inches and the resistence at the side twenty-four tons, what must be the force upon the head? Ans. 3 tons.

The distance between the threads of a Screw, *the length of the lever, and power applied being given, to find the weight.*

Rule. — Place the circumference of the circle described by one revolution of the lever and the power applied on the right hand side of the line, and the distance between the threads of the screw on the left hand side.

Proposition 1. If the threads of a screw be two inches asunder, the lever thirty-five inches in length, and a power of sixty pounds be applied, to the end of the lever what weight will be required to produce an equilibrium?

$$\begin{array}{r|l} -2 & 220 \\ & 60-30 \\ \hline & 6600 \end{array}$$

6600 pounds, Ans.

2. If the threads of a screw be three inches apart the lever $24\frac{1}{2}$ inches in length and a power eighty pounds be applied to the end of the lever, what weight will be required to produce an equilibrium?

Ans. $4106\frac{2}{3}$ pounds.

3. Should the threads of a screw be $2\frac{1}{2}$ inches asunder, the lever twenty-eight inches in length and a power of four tons be applied to the end of the lever, what weight will be required to produce an equilibrium?

Ans. $281\frac{3}{5}$ tons.

4. Should the threads of a screw be $4\frac{4}{11}$ inches asunder, the lever thirteen inches in length, and a power of four tons be applied to the end of the lever, what weight will be required to produce an equilibrium?

Ans. $4\frac{1}{4}$ cwt.

The weight of the lever and the distance between the threads of a Screw being given, to find the power requisite to produce an equilibrium.

Rule.— Place the given weight and distance between the threads of the screw on the right hand side of the line and the circumference of the circle described by one revolution of the lever, on the left hand side.

Proposition 1. How many pounds applied to the end of a lever $36\frac{1}{11}$ inches in length will balance twenty tons upon a screw whose threads are two inches asunder?

$$\begin{array}{r|l} & 20 \text{ pounds, Ans.} \\ \text{-2-224.} & 112\text{-} \\ & 2\text{-} \end{array}$$

2. How many pounds applied to the end of a lever thirty-five inches in length will balance fifteen tons upon a screw whose threads are $2\frac{1}{2}$ inches apart? Ans. $3\frac{9}{22}$ cwt.

3. Required the number of pounds requisite to produce an equilibrium of twenty-four tons upon a screw whose threads are $2\frac{2}{4}$ inches asunder, and lever twenty-eight inches.

Ans. $6\frac{9}{11}$ cwt.

4. The threads of a screw are two inches asunder, the length of the lever seventy inches, required the number of pounds to produce an equilibrium, the weight applied to the lever being seventy-two tons. Ans. $6\frac{6}{11}$ tons.

To ascertain the atmospheric pressure upon a cylinder.

Rule. — Place the square of the number of inches in the diameter, and 165 on the right hand side of the perpendicular line and 14 on the left hand side.

Prop. 1. Required the atmospheric pressure upon a cylinder whose diameter is twenty-eight inches.

-14	28-2--
-28	28-
2-4	165-82½ cwt. Ans.

2. Required the atmospheric pressure upon a piston of a steam engine whose diameter is fifty-six inches. Ans. 16 tons 10 cwt.

3. The diameter of a cylinder is 2⅓ inches. Required the atmospheric pressure. Ans. 64⅛ lbs.

3. Required the atmospheric pressure upon a pisson of a common pump, the diameter of which is seven inches. Ans. 577½ lbs.

4. Required the atmospheric pressure upon a piston of a cylindrical vessel whose diameter is seventy inches. Ans. 25 tons 15 cwt. 2 qrs. 14 lbs.

6. The diameter of cylindrical vessel is fourteen inches. Required the atmospheric pressure upon its piston. Ans. 20⅝ cwt.

7. The diameter of a cylindrical vessel is thirty-eight inches. Required the atmospheric pressure on its piston. Ans. 7 tons 11 cwt. 3 qrs. 22 lbs.

To find the number of balls contained in a
lar pile.

Rule — Place the number of balls containe
row increased by 2, the number of balls contai
row increased by 1, and the number of balls con
tom row on the right hand side of the perpendic
the left hand side.

Prop. 1. Required the number of b
in a finished triangular pile, the botton
ing of eight on a side.

-2-6 | 10
| 9-3
| 8-4

120 Ans.

2. Required the number of balls c
finished triangular pile, the bottom ro
thirty on a side.

3. How many balls are contained i
angular pile, each side of whose base c
balls ?

4. Required the number of balls
finished triangular pile, the bottom ro
sixty on a side.

To find the number of balls contained in
pile.

Rule.— Place twice the humber of balls c
of the square increased by 1, the number of b
side of the square increased by 1 and the numb
ed in the side of the square on the right hand
dicular line, and 6 on the left hand side.

Prop. 1. Required the number of
in a finished square pile containing
side.

$$\begin{array}{r|l} & 25 \\ -6 & 13 \\ & 12\text{-}2 \\ \hline & 650 \text{ Ans.} \end{array}$$

2. Required the number of balls contained in a finished square pile, the lower tier containing thirty in each. Ans. 9455.

3. Required the number of balls contained in a finished square pile, each side containing twenty balls. Ans. 2870.

Required the number of balls contained in a finished square pile, each side containing twenty-three balls.

To ascertain the number of balls contained in a finished rectangular pile.

Rule. — To twice the number of courses increased by 1, add the the product of the number less by 1 in the top row multiplied by 3, and place the sum together with the number of courses increased by 1, and the number of courses on the right hand side of the line, and 6 on the left hand side.

Prop. 1. The number of courses in a finished rectangular pile is thirty, and the number in the top row is thirty-one, required the number contained in the pile.

$$\begin{array}{r|l} & 151 \\ -6 & 31 \\ & 30\text{-}5 \\ \hline & 23405 \text{ balls Ans.} \end{array}$$

2. The number of courses in a finished rectangular pile is twenty, and the number in the upper course is twenty four, required the number contained in said pile. Ans. 7700.

3. The number of shot in the upper course of a finished rectangular pile is forty-one, and the number of courses thirty, how many shot are contained in said pile? Ans. 28055.

4. How many shot are in a finished rectangular pile, the length of the bottom course being fifty-nine and its breadth twenty? Ans. 11060.

MACHINERY.

To ascertain the number of revolutions that a drum, pulley or spindle will make, when connected together by belts or bands, the velocity of one and diameter being given,

RULE. — Place the velocity and diameter of the drivers on the right hand side of the perpendicular line, and the diameter of the driven on the left hand side of the line.

Prop. 1. A belt connects a drum of two feet in diameter, making forty revolutions in a minute with one of four inches in diameter. Required the velocity of the smaller drum.

4 | 40
| 12-3
| 2

240 revolutions per min. Ans.

2. How many revolutions will a spindle of two inches in diameter make, connected to a drum of three feet in diameter performing thirty revolutions per minute? Ans. 540

3. A drum of four feet in diameter performs sixty revolutions per minute. Required the diameter of that drum, whose velocity is 576 revolutions per minute. Ans. 5 inches.

4. What is the twist of yarn per inch, spun on a mule with the following geer, pullies, &c.: geer on front roller, 54 teeth; geer on lower end of tumbling shaft, 27 teeth; geer on upper end of tumbling shaft, 34 teeth; geer on fly wheel shaft, 50 teeth; diameter of fly wheel, 36 inches; diameter of twist pully, where rim band runs, 16 inches; diameter of twist pully, where drum bands run, 12½ inches; diameter of drum, where the drum band runs, 10½ inches; diameter of drum where spindle band runs, 10 inches; diameter of spindle whirl, 1 inch; diameter of front roller, 1 inch.

Solution.

-27	54- 2-
-2 --50	44- 2-
-2 -8 -16	36- 12- 3
-2	25-
-3 -21	2-
	10- 5
-22	7-

15 turns per inch Ans.

5. What is the draft of a spinning frame, front roller 1½ inches; diameter of back roller ⅝ of an inch; pinion on front roller 40 teeth, stud 84 to 21 teeth; geer on back roller 50 teeth.

--2	3--
--6	8--
--5 --40	84-- 4--
--21	60-- 10

10 is to 1, Ans.

SQUARE ROOT.

The square of a number is the product arising from a number multiplied into itself.

The extraction of the square root is the finding of such a number as, being multiplied itself, will produce the number proposed.

Rule. Separate the given number into periods of two figures each, beginning at the units' place.

Subtract from the first period at the left hand the greatest square it contains, setting the root of that square as a quotient figure, and doubling said root for a divisor, and bring down the second period to the remainder for a dividend.

Try how often the said divisor (with the figure used in the trial thereto annexed) is contained in the dividend, and set this figure in both the divisor and root; then multiply and subtract, as in division, and bring down the next period. Double the ascertained root for a new divisor, and repeat the process to the end.

Proof. Square the root, adding in the remainder, if any, and the result will equal the given number.

EXAMPLE.

What is the square root of 30138,696025?

```
              *   *   *   *
1    )   30138, 696025 (173,605
1        1
------------
27)   201
 7    189
--------------
343)  1238
  3   1029
-----------------
3466)  20969
   6   20796
----------------------
347205)  1736025
         1736025
         -------
```

CUBE ROOT.

The cube of a number is the product of that number multiplied by its square.

The extraction of the cube root is the finding of such a number as, being multiplied into its square, will produce the number proposed.

Rule. — Point off the given numbers into periods of three figures each, and find the nearest cube to the first period; subtract it therefrom, and put the root in the quotient; then thrice the square of this root will be the trial divisor for finding the next figure.

Set off a little to the left the next figure; with thrice the preceding figure of the root; multiply this by the last fig

ure, and set this under the trial divisor, remo
ures to the right, and the sum will be the tru
Under this divisor put the square of the la
ure of the root, which add to the two sums al
sum will be the trial divisor for finding the
the root; then the true divisor is found, as be

EXAMPLES.

What is cube root of 205379?

3 multiplied by $5^2 = 75$		205379(
159 .	. 1431	125
	8931	80379
		80379

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